UNITED STATES ATOMIC ENERGY COMMISSION

Annual Report to Congress

OF THE

ATOMIC ENERGY COMMISSION

FOR

1967

January 1968

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UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON, D.C.

· (in millions)

ed te c-	Total
.0	$269.6
.3	3.2
.3	272.8
.5	112.1
.2	84.9
.1	4.0
---	2.4
.3	1,215.8
---	4.7
---	1.3
6	10.7
6	12.0
7	6.8
6	14.0
3	20.8
3	3.1
8	99.9
0	$9,733.5

1, 1966

LETTER OF SUBMITTAL

WASHINGTON, D.C.,
January 31, 1968.

SIRS: We have the honor to submit herewith the Annual Report of the United States Atomic Energy Commission for 1967 as required by the Atomic Energy Act of 1954.

Respectfully,

UNITED STATES ATOMIC ENERGY COMMISSION,
JAMES T. RAMEY.
GERALD F. TAPE.
WILFRID E. JOHNSON.
GLENN T. SEABORG, *Chairman.*

The Honorable
The President of the Senate.
The Honorable
The Speaker of the House of Representatives.

Chapter 3

THE NUCLEAR DEFENSE EFFORT

The AEC, in coordination with the Department of Defense, conducts basic and applied research on nuclear weapons and device development, tests devices and weapons and their components, and produces nuclear weapons essential to the maintenance and advancement of the United States nuclear defense capability.[1]

NUCLEAR WEAPONS

During 1967, the AEC continued: (*a*) the development and production of nuclear weapons and components designed to meet Department of Defense (DOD) requirements; (*b*) the development of nuclear devices and improved data acquisition systems and diagnostic instrumentation techniques for underground testing; (*c*) in consonance with the limited nuclear test ban treaty safeguards,[2] its readiness to resume atmospheric testing; and (*d*) its participation in the DOD-sponsored nuclear detonation detection (Vela) research program.

WEAPONS DEVELOPMENT

Weapons development activities include the design and development, and testing of the nuclear portion, and the non-nuclear components, of atomic weapons. A major effort is being devoted to

[1] Twelve Mutual Defense Agreements for Cooperation are currently in effect (see Appendix 7—Agreements for Cooperation).

[2] The four safeguards announced as U.S. national policy prior to Senate ratification of the limited nuclear test ban treaty in 1963, are: (*1*) continuation of an aggressive underground nuclear weapons test program, (2) maintenance of a progressive laboratory program, (*3*) a readiness capability to resume atmospheric tests if they should be essential to national security or if the treaty should be abrogated, and (*4*) the improvement of our capability, within feasible and practical limits, to monitor the terms of the treaty and to detect violations.

the development of new nuclear warheads required by the Department of Defense. Primarily, the weapons development work is conducted by the AEC's three weapons laboratories (Los Alamos Scientific Laboratory, Los Alamos, N. Mex.; the Lawrence Radiation Laboratory, Livermore, Calif.; and the Sandia Laboratory facilities at Albuquerque, N. Mex., and Livermore, Calif.).

Development and Test Complexity Increasing

The laboratories continued to develop advanced experimental techniques in underground testing. These efforts increase the value of underground tests as a tool for checking nuclear device concepts for weapons design, and for effects evaluation. Other efforts were directed toward the development of weapon components through the use of new materials and fabrication techniques. Development continued on methods to improve and simplify command and control procedures and to prevent the possibility of unauthorized use of nuclear weapons.

Underground nuclear weapon development tests continued to be conducted during the year. These included tests of increased yield, instrumentation systems of increased complexity, and experiments directed toward hardening and determining vulnerability of weapons systems. Nuclear effects tests required in support of development programs also were conducted. In addition to those tests sponsored by the AEC, support was given to nuclear events sponsored by the DOD.

Basic and applied research continued in 1967, both to provide increased knowledge of nuclear phenomena and to meet program goals. This broad program enabled the laboratories to continue to advance the "state-of-the-art." Laboratory employment remained stable and the laboratories were able to recruit the necessary staff personnel.

WEAPONS PRODUCTION

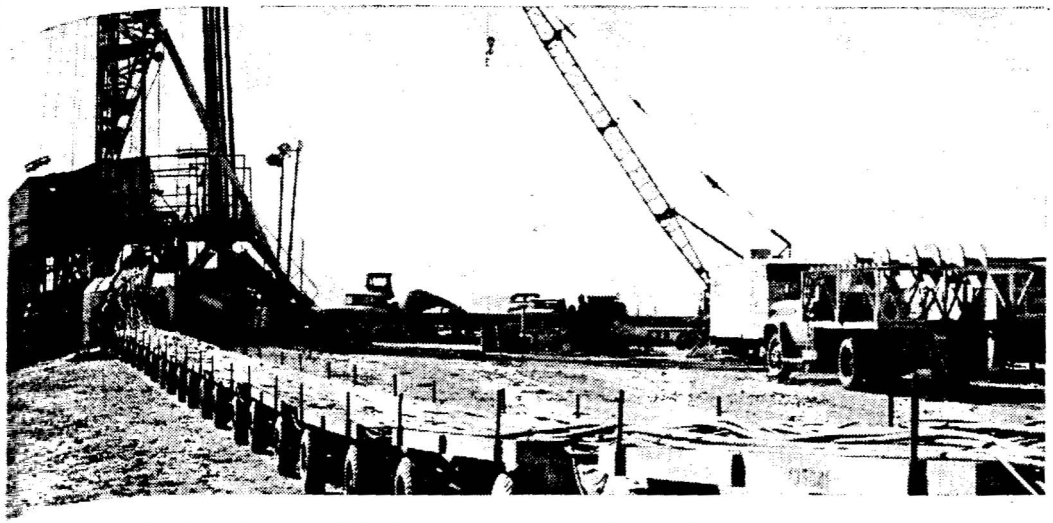
The 1967 weapons production effort, in support of requirements, was somewhat less than the 1966 workload.

Stockpile Improvement

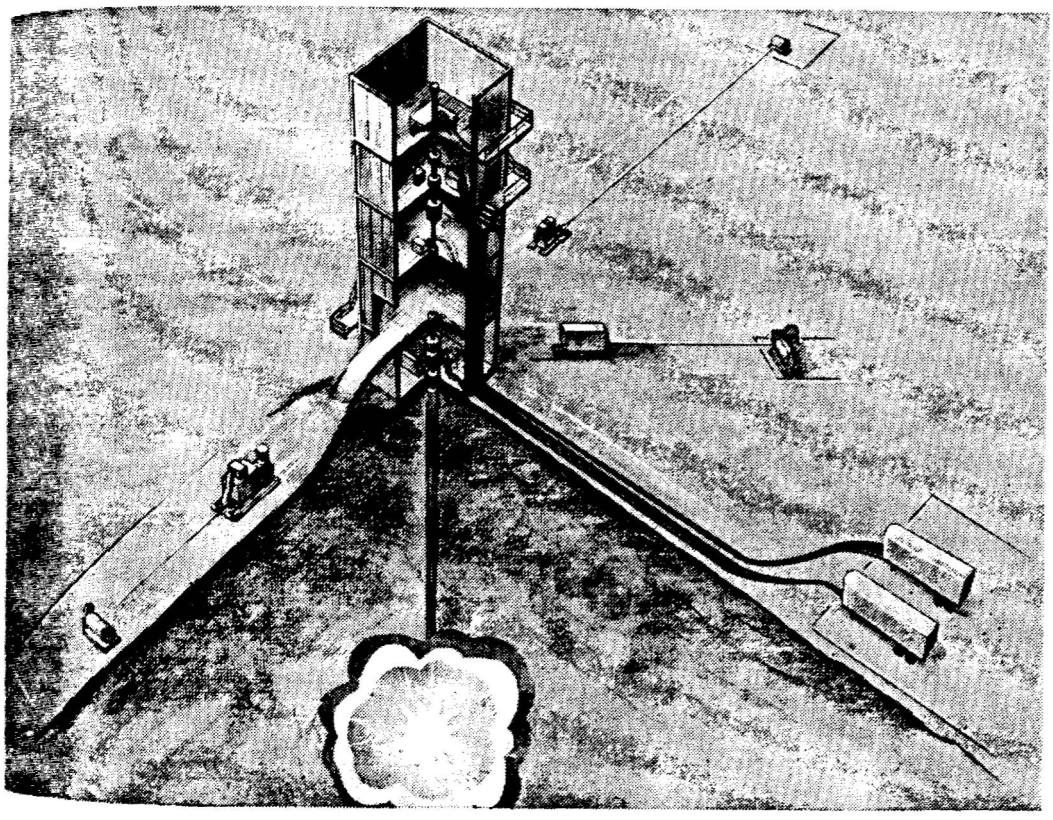
Weapons production activities, in addition to the production of new weapons, provided for improved replacement systems, modifications to existing systems, quality assurance and new materials system testing, and retirement and disposal of obsolete weapons.

Continuing emphasis has been placed upon meeting production objectives at minimum cost. This facet of production begins with the

Underground cable require Electrical ar *(above)* elim the huge leng of damage t Schematic dr onation. The neutrons fro tower. Some *right)* ; targe from the sled the detonati delicate instr



Underground Tests. To simplify handling of millions of feet of coaxial and signal cable required for "down hole" operations at the Nevada Test Site, the Reynolds Electrical and Engineering Co. transports the long lengths of cable on carts (*above*) eliminating much of the manpower previously needed to manually handle the huge lengths of heavy cable. The "cart" innovation also reduces the chance of damage to the cables, thus increasing their usefulness in further testing. Schematic drawing *below* shows how scientific data can be obtained from a detonation. The tower is located over the "line-of-sight" vacuum pipe up which the neutrons from the nuclear explosion travel to the experiments housed in the tower. Some data is carried by coaxial cable to the instrumentation vans (at right); target materials bombarded by the intense flow of neutrons are recovered from the sleds which can be winched away from the tower within seconds after the detonation, before the earth shock or surface subsidence can affect the delicate instrumentation.



design and development of weapons and their components. It includes cost consciousness in the design process and in the planning and execution of the weapons production phase.

Production Facilities To Be Modernized

In mid-1967, after extensive study of needs, a $100.5 million project to provide additional production capabilities was authorized. The modernization and expansion of facilities, expected to be completed by late 1971, will provide the facilities and improvements needed to produce new weapon systems required by the DOD. The major portions of the modernization will be undertaken at the Y–12 Plant, Oak Ridge, Tenn.; at the Rocky Flats Plant, Golden, Colo.; and lesser portions at the Pinellas Plant, Clearwater, Fla.; Savannah River Plant, S.C.; Pantex Plant, Amarillo, Tex.; and at the Burlington AEC Plant, Iowa.

The decision in October to deploy an antiballistic missile system is resulting in a further expansion of the weapons production facilities. This expansion will become a part of the presently authorized project.

UNDERGROUND NUCLEAR TESTS

The AEC continued to conduct an underground nuclear test program at the Nevada Test Site (NTS). Such tests are permitted under the limited nuclear test ban treaty (signed August 5, 1963, by the United States, the United Kingdom, and the U.S.S.R.). Through a comprehensive series of underground tests, a capability has been developed to support a wide range of full-scale underground experiments. Additional new and improved methods were developed for conducting experiments underground.

Latchkey—Crosstie Series

The planned nuclear tests for the current Crosstie series (July 1, 1967–June 30, 1968) are grouped in four broad categories, three of which support the national defense effort: (*a*) weapons-related, including device development, tests; (*b*) Department of Defense nuclear effects tests; (*c*) joint AEC–DOD nuclear tests designed for research and development on improving detection methods and systems (Vela Uniform). The fourth category is Plowshare (peaceful uses of nuclear explosives) experiments (see Chapter 11—The Plowshare Program).

Nuclear tests are reviewed, and will continue to be reviewed, in accordance with AEC-developed procedures for public safety. Tests are conducted only with the expectation that they can be executed within the constraints of the limited nuclear test ban treaty.

Test Event Summary

Fifteen weapons-related underground tests, including one DOD effects test, were publicly announced in 1967 under the Latchkey series (July 1, 1966–June 30, 1967). Ten weapons-related tests, including one DOD effects event, have been publicly announced in the 1967 Crosstie series. Two of the 25 weapons-related tests announced in 1967 were conducted in the higher-elevation Pahute Mesa area [3] of NTS where deeper emplacement holes allow higher yield detonations. (See Appendix 4 for names and dates of defense-related tests announced during 1967.)

Supplemental Test Sites

A site-selection program [4] to locate and develop underground test facilities to supplement the present Nevada Test Site has led to a choice of Hot Creek Valley in central Nevada and Amchitka Island in Alaska as locations for further investigation. No other areas are now under active consideration.

The use of supplemental test sites is not expected to affect the programs now conducted at the Nevada Test Site.

Central Nevada Site. Hot Creek Valley, about 70 miles northeast of Tonopah, is about 15 miles long and 5 to 7 miles wide. Extensive exploratory drilling, hydrologic testing, and geophysical investigations were undertaken at Hot Creek during the first half of 1967. The AEC plans to conduct an intermediate yield calibration test at Hot Creek in early 1968 to gain information on the seismic effects and to explore the possibility of conducting other detonations at the site. An austere temporary camp and a portable control point have been erected near Warm Springs, approximately 30 miles from the calibration site. The AEC does not plan acquisition of extensive real estate. Only one square mile of public land will be withdrawn from public use for the calibration test. Under the plan for future testing, similar small public land areas surrounding the emplacement holes will be withdrawn. Larger areas will be subject to safety control during the test periods.

[3] See p. 126, "Annual Report to Congress for 1966."
[4] See pp. 126–128, "Annual Report to Congress for 1966."

Alaskan Island Site. Amchitka is an uninhabited island near the western tip of the Aleutian Chain, about 42 miles long and 3 to 5 miles wide. The remoteness of Amchitka Island avoids most of the safety problems (such as those directly related to seismic effects on buildings) and land ownership problems which would have confronted the AEC in Nevada. The AEC has cooperated closely with the U.S. Department of the Interior in measures to minimize the impact of human presence on the island with a minimum of disturbance to wildlife.

Atmospheric Test Readiness. The AEC, in association with the Department of Defense, maintains a state of readiness to quickly resume atmospheric testing if the limited nuclear test ban should be abrogated. As a part of this readiness, the specially instrumented NC–135 diagnostic aircraft (shown *above*) are used from time-to-time in joint scientific expeditions with other Federal agencies to provide experience for the crews and diagnostic technicians. Two of the atmospheric diagnostic aircraft, assigned to Los Alamos Scientific Laboratory and Sandia Laboratory, were used in March and April for a scientific experiment to obtain geophysical measurements of the earth's upper atmosphere and geomagnetic field. While Los Alamos personnel flew to Alaska, the Sandia crew flew to New Zealand with duplicate instruments to gather data simultaneously at two separate points on the auroral spectrum and cosmic rays at magnetic conjugate points. The Sandia group then flew on an equatorial path around the world to measure the distribution and intensities of cosmic rays and air glow as a function of altitude, latitude, and longitude. The flights in the northern and southern hemispheres provided the AEC technical and Air Force flight personnel additional experience in instrumentation and aircraft operation during a non-test period.

...d to the natural environment. Amchitka was the site of the DOD-...nsored, deep underground Long Shot test [5] (Vela detection) in ...tober 1965. Long Shot caused no significant damage to the island ...its wildlife. The AEC awarded a contract for a drilling program ...oth exploratory and event emplacement holes) at Amchitka in ...March 1967 and, at year's end, drill rigs were operating on Amchitka. ...conjunction with that work, harbor facilities have been built and ...rfield facilities have been improved. A temporary 500-man camp ...s been set up on the southeast part of the island.

ATMOSPHERIC TEST READINESS CAPABILITY

The AEC continues to maintain and improve the capability for ...sumption of nuclear testing in the test ban treaty prohibited environ-...ents should it be directed to do so in the event of an abrogation of ...e treaty, or in the interest of national security. If necessary, the AEC will be able to resume testing in the atmosphere, underwater, ...in space, within a minimum reaction period. This capability was ...itially attained on January 1, 1965.

Overseas facilities (Johnston Atoll and the Hawaiian Island com-...lex) and their technical equipment are being held in readiness. ...uring 1967, maintenance and reliability improvement efforts were ...ept abreast of laboratory-generated advances in technology.

Non-nuclear airdrop readiness exercises were conducted to maintain ...e diagnostic capability, increase technical proficiency, and to exer-...se the airborne diagnostic capability.

VELA PROGRAM ACTIVITIES

The Vela program is a joint AEC/DOD program supervised by ...e DOD's Advanced Research Projects Agency (ARPA). It is a ...search and development effort conducted to improve the U.S. capa-...lities of detecting, locating, and identifying nuclear detonations. ...e total AEC effort devoted to Project Vela is less than 1 percent ...f the weapons program operating budget.

Vela Uniform

The Vela Uniform program uses both nuclear and chemical explo-...ons to provide data needed to evaluate the U.S. capability to detect

[5] See pp. 107–108, "Annual Report to Congress for 1965."

underground nuclear tests. The DOD has the administrative, funding (less nuclear device and diagnostics), and technical responsibility for this program. The AEC is responsible, in connection with nuclear tests, for: (*a*) construction and firing; (*b*) determining yield and conducting post-shot drilling; (*c*) instruments for close-in measurements; and (*d*) public safety. Four underground nuclear experiments have been conducted under this program.[6]

Measurements of ground shock accelerations and other effects, and the operation of both short and long-range seismic recording stations continued during 1967 in conjunction with NTS underground tests.

Status of Salmon-Sterling Site

During part of 1967, the Mississippi facilities used for the Salmon (1964) and Sterling (1966) tests were maintained on a standby basis. ARPA has now requested that the AEC drill into the Salmon-Sterling cavity to determine its suitability for possible future use. This will be done in early 1968.

Other Vela Uniform Experiments

An underground experiment, called Scroll, is planned for 1968 at the NTS as a low-yield event in a low-moisture content and high-porosity soil medium.

Another test called Payette, has been proposed as a fully decoupled[7] event of low yield in a large underground cavity in salt. A feasibility study is underway to establish the best methods and the economics of constructing such an underground cavity.

Project Gasbuggy, a joint Plowshare-industry experiment (see Chapter 11) near Farmington, N. Mex., in December included Vela Uniform experiments. Adjacent boreholes that would not interfere with the Gasbuggy project were drilled and instrumented to record characteristics of close-in seismic coupling in a sand-shale medium, and surface seismic measurements.

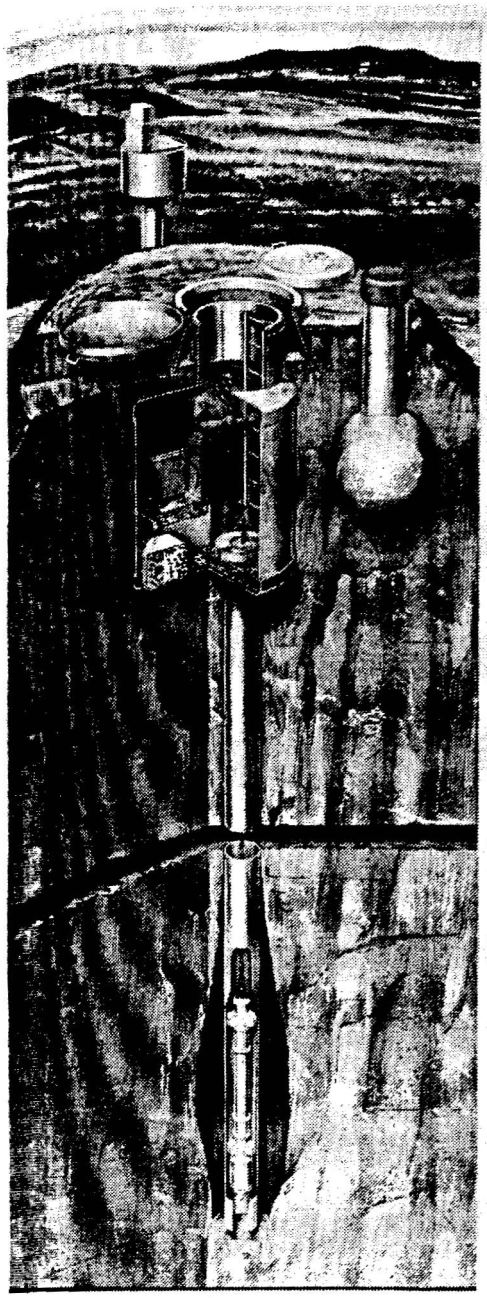
Vela Satellite Program

The AEC continues to participate in the joint DOD-AEC Vela Satellite program. Under the program, Sandia and Los Alamos Scien-

[6] Vela Uniform events conducted to date were: Shoal, October 26, 1963, near Fallon, Nev.; Salmon, October 22, 1964, near Hattiesburg, Miss.; Long Shot, October 29, 1965, Amchitka Island, Alaska; and Sterling, December 3, 1966, in the Salmon event cavity.

[7] "Decoupled" is the use of an underground cavity in such a way as to reduce the amount of shock and earth movement imparted to the surrounding medium. In this way, the true magnitude of the explosion may be concealed or the effects may be reduced below the capabilities of a detection system.

Unmanned ... prototype un... emplaced by ... to monitor, i... installed for ... Vernel, Utah ... as much a... electronic sy... maintenance ... the bore-hol... gyros and r... ponents for ...



INSTALLATION SITE

BOREHOLE PACKAGE

manned Seismic Observatory. Diagram on *left* shows the installation of a prototype unattended seismological observatory (USO) designed, fabricated, and placed by Sandia Laboratory personnel as part of the Vela Uniform program monitor, identify, and locate underground disturbances. Two USO's have been stalled for a year's evaluation, one near Fairbanks, Alaska, the other near rnel, Utah. The seismometer package is at the bottom of a cased borehole as much as 200 feet deep). The small shelter just below the surface houses tronic systems and timing and recording devices—accessible to personnel for intenance and servicing required about every 90–110 days. The cut-away of bore-hole package (on *right*) shows the system of seismometers, alignment s and rotating mechanisms, upper and lower locking feet, and other com- ents for sensing and reporting seismic pulses.

tific Laboratory are doing research and development toward a means to detect and identify nuclear explosions in space or down into the atmosphere through satellite-based systems.

Status of Orbiting Satellites

Eight AEC-instrumented, orbiting Vela nuclear test detection satellites are performing test ban monitoring functions. The newest pair (Launch IV) were placed in orbit on April 28, 1967, using a Titan IIIC booster system. The two new sentries are earth-oriented in 180°-spaced positions on a nearly circular orbit of about 65,000 nautical miles radius, comparable to the previous six. Earth-orientation aids in the recording of optical and electromagnetic radiations from nuclear detonations that might be conducted in the atmosphere. Improved detector systems for neutrons, gamma rays, and X-rays for high-altitude and space surveillance are employed. Instruments also obtain data on background radiations, primarily those emitted from the sun.

The six earlier satellites were placed in orbit in pairs with Atlas-Agena booster systems in October 1963, July 1964, and July 1965. In addition to performing their test ban monitoring functions, they have reported a wealth of new scientific data on the solar wind and its interaction with the magnetic fields around the earth.

A fifth launch of twin satellites is scheduled for the future. They will have increased nuclear test detection capabilities and will involve earth-oriented spacecraft. The launch will use a Titan IIIC booster.

Vela Surface Detection Program

The AEC, with LASL conducting the research and development, participates with the DOD in studies on the ground-based detection of nuclear explosions in space. The joint program is directed primarily at the air fluorescence detection method. The concept is based on the measurement of the fluorescent light produced in nitrogen when high-altitude air is bombarded by X-rays from a nuclear explosion.

Results of a joint AEC-DOD lightning study, conducted at LASL in the summer of 1965, have led to improvements in the ability to discriminate between nuclear weapon detonations and lightning flashes.